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भाग 1 सामान्य

Indian Standard

SEMICONDUCTOR DEVICES — INTEGRATED CIRCUITS

PART 1 GENERAL

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BUREAU OF INDIAN STANDARDS
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Price Group 5

Semiconductor Devices and Integrated Circuits Sectional Committee, LTD 10

FOREWORD

This Indian Standard (Part 1) was adopted by the Bureau of Indian Standards on 29 January 1990, after the draft finalized by the Semiconductor Devices and Integrated Circuits Sectional Committee had been approved by the Electronics and Telecommunication Division Council.

This standard deals with general conditions (such as cooling), preferred voltage and current ratings, measurement temperature, format for the presentation of data, etc, as a basis and guide for the other standards dealing with specific categories or sub-categories of integrated circuits.

This standard (Part 1) is one of the series of standards on integrated circuits. Other parts of this standard are as follows:

Part 2 : Digital integrated circuits — Essential ratings and characteristics

Part 3 : Digital integrated circuits — Measuring methods

Part 4 : Digital integrated circuits — Acceptance and reliability

Part 5 : Analogue integrated circuits — Essential ratings and characteristics

Part 6 : Analogue integrated circuits — Measuring methods

Part 7 : Analogue integrated circuits — Acceptance and reliability

This standard is based on IEC Pub 748-1 'Semiconductor devices — Integrated circuits—Part 1 : General', issued by the International Electrotechnical Commission (IEC).

For the purpose of deciding wheather a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*). The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

SEMICONDUCTOR DEVICES — INTEGRATED CIRCUITS

PART 1 GENERAL

1 SCOPE

1.1 This standard (Part 1) provides information on the general principles or requirements applicable to digital and analogue integrated circuits.

2 REFERENCES

2.1 The following Indian Standards are necessary adjuncts to this standard:

IS No.	*Title*
1885 (Part 7/ Sec 5) : 1971	Electrotechnical vocabulary: Part 7 Semiconductor devices, Section 5 Integrated circuits and micro electronics
3715 (Part 1) : 1971	Letter symbols for semiconductor devices: Part 1 General aspects
5000 Series	Dimensions of semiconductor devices

3 TERMINOLOGY AND EXPLANATION OF TERMS

3.1 For the purpose of this standard, the terms and definitions given in IS 1885 (Part 7/Sec 5) : 1971 shall be applicable in addition to the following.

3.2 Basic 'Rating' Definitions

3.2.1 *Rating*

The value of any electrical, thermal, mechanical or environmental quantity assigned to define the operating conditions under which a component, machine, apparatus, electronic device, etc, is expected to give satisfactory service.

NOTE — 'Rating' is a generic term, but see also rating (limiting value).

3.2.2 *Rating (Limiting Value)*

A rating which establishes either a limiting capability or a limiting condition beyond which damage to the device may occur.

NOTE — Limiting conditions may be either maxima or minima, known as maximum ratings and minimum ratings respectively.

3.3 Definitions of Cooling Conditions

3.3.1 Semiconductor devices should be specified either as ambient-rated, case-rated or both ambient and case-rated devices. Where devices are specified as ambient-rated devices, this infers natural air cooling conditions (air under conditions of natural covection) unless otherwise stated.

For the purposes of rating, the following definitions shall apply:

a) *Ambient rating method*

A method in which the ratings are quoted in terms of the ambient cooling conditions.

b) *Ambient rating devices*

Semiconductor devices for which the ratings are quoted in terms of the ambient cooling conditions.

c) *Ambient cooling conditions*

The conditions of the surroundings determining the manner in which heat is removed from the device. These conditions concern the cooling fluid and the mounting of the device and are specified by some or all of the following:

Fluid	*Mounting*
Type	Device orientation and support to any enclosure
Temperature at a specified point ahead of the device in the line of flow	Temperature of the terminal connections
Flow (natural convection at a given pressure, or forced cooling in terms of velocity and inlet pressure)	Length and thickness of connecting leads. Sorrounding surface condition and temperature

For the purpose of standardization, the following definition has been adopted for devices where the ambient temperature is called for under conditions of natural air cooling.

i) *Ambient temperature under conditions of natural air cooling*

The temperature measured below a semiconductor device when it is supported by its leads in an enclosure of a substantially uniform air temperature having low reflectance surfaces. The support points for the device should not be less than 10 mm from the body of the device, except for devices having very short leads, in which case the location of the support points must be specified. The supports shall be at a temperature no less than that of the ambient temperature. The enclosure should be constructed so that natural air convection is not materially affected.

ii) *Reference-point temperature*

The temperature measured by a specified method at a point on the device by the device manufacturer.

iii) *Case rating method*

A method in which the ratings are quoted in terms of the temperature of a reference point on the device.

iv) *Case-rated devices*

Semiconductor devices for which the ratings are quoted in terms of the temperature of a reference point on the device.

3.4 Open Circuit

A circuit should be considered open-circuited if a two-to-one decrease in its impedance does not produce a change in the measured value of the parameter that is greater than the permitted error of measurement.

3.5 Short Circuit

A circuit should be considered short circuited if a two-to-one increase in its impedance does not produce a change in the measured value of the parameter that is greater than the permitted error of measurement.

3.6 Small Circuit

A signal should be considered small-circuited if a two-to-one increase in its magnitude does not produce a change in the value of the parameter that is greater than the permitted error of measurement.

3.7 Constant Current Source

A current source should be considered constant if a two-to-one increase in the load impedance does not produce a change in the value of the parameter that is greater than the permitted error of measurement.

3.8 Constant Voltage Source

A voltage source should be considered constant if a two-to-one decrease in the load impedance does not produce a change in the measured value of the parameter that is greater than the permitted error of measurement.

3.9 Pulse Measurement

For measurement using pulse technique, when duty factor, pulse duration and repetition frequency are not specified, these should be chosen that the change, in the measured value of the parameter does not exceed the permitted error when:

a) the initial pulse duty factor is doubled, and

b) the initial pulse duration is doubled or the pulse repetition frequency is halved.

4 LETTER SYMBOLS

4.1 For the purpose of this standard, the letter symbols given in IS 3715 (Part 1) : 1971 shall be applicable.

5 ESSENTIAL RATINGS AND CHARACTERISTICS

5.1 Introduction

The standards given in this series generally constitute the minimum data to be quoted by a manufacturer when describing his product for general sale. There are however, products that perform well in special circuits without being specified for all the characteristics mentioned in these standards. Therefore, such products may be excluded from these standards.

When typical values are required in these standards, it should be understood that they are intended for engineering guidance and not guaranteed values.

5.2 Standard Format for the Presentation of Published Data

The published data should be preserved in accordance with the following list. It is not compulsory to indicate data for all the items in this list:

a) Type number.

b) Category of the device according to the relevant standard. The semiconductor material (for example, silicon) and, where appropriate, the polarity should be stated.

c) Information on outline, terminal identification and connections (*see* Note), case material (glass, ceramic, metal plastic, etc) and the finish of leads.

NOTE — Details of any connection between the case and any of the terminals should be stated.

d) Ratings (electrical, thermal and mechanical) according to the relevant standard.

e) Electrical and thermal characteristics and associated information according to the relevant standard.

f) Mechanical data, according to the relevant standard.

g) Environmental data, according to the relevant standard and/or reliability data.

h) Curves, for example, graphical representation of characteristics.

5.3 List of Preferred Temperatures

5.3.1 The temperature used for stating the ratings for analogue and digital circuits should be chosen from the following list:

−65°C; −55°C; −40°C; −25°C; −10°C; 0°C; 25°C; 55°C; 70°C; 85°C; 100°C; 125°C; 150°C; 175°C; 200°C.

NOTE — The values −65°C, 150°C, 175°C and 200°C apply only for storage temperature.

5.4 List of Preferred Voltages

5.4.1 List of preferred nominal voltages for recommended operating conditions:

a) *Digital circuits*

The voltages used for stating the recommended operating conditions should be, wherever possible, chosen from the following list:

— *Bipolar circuits* : 1·5V; 5·0V; 5·2V (for ECL only); 12V; 15V.

NOTE — These values do not concern integrated injection logic circuits (I^2L) for which it is difficult to give values at present.

— *MOS circuits* : 1·3V; 1·5V; 3·0V; 5·0V; 12V; 15V; 18V; 24V.

When it is not possible to use a value from these lists, it is recommended that value of the voltage be chosen, fromt he following list: 4·0V; 6·0V; 9·0V; 30V; 48V; 100V.

NOTE — When new technologies are introduced, it isrecommended that values for supply voltage be chosen from those given in the above list of preferred voltages.

b) *Analogue circuits*

The voltages used for stating the recommended operating conditions should be chosen from the following list:

1·3V; 1·5V; 3·0V; 4·0V; 5·0V; 6·0V; 9·0V; 12V; 15V; 18V; 24V; 30V; 36V; 48V; 100V.

5.4.2 *Tolerance on Voltages*

The following values of positive and negative tolerances, applicable to all types of integrated circuits, are recommended:

5 percent; 10 percent; 20 percent.

The tolerances above and below the nominal value, that is, the positive and the negative tolerance, need not necessarily be the same.

5.5 Mechanical Ratings, Characteristics and Other Data

5.5.1 *Introduction*

The following information on mechanical ratings, characteristics and other data applies generally to semiconductor devices of all categories. The clauses should be invoked as appropriate to the mechanical construction of the device concerned, for example, wire ended, stud mounted device, etc.

5.5.2 *Mechanical Ratings (Limiting Values)*

In the following clauses on mechanical ratings, the preferred method of stating the information required should be in accordance with the relevant standard. Unless otherwise stated, all ratings apply at a temperature of 25°C.

5.5.2.1 *Ratings for terminations*

a) *Stress ratings*

A statement of any restrictions on the stresses which may be applied should be given.

b) *Temperature rating*

The maximum temperature of the terminations at a specified distance from the body for a specified time, together with any other limiting conditions, should be given as appropriate to the intended method(s) of attachment (for example, soldering, welding, etc).

When these ratings are significantly dependent on the initial temperature of the device; any information on derating should be given.

5.5.2.2 *Mounting conditions*

Where appropriate, any significant conditions and/or any restriction should be stated, for example:

a) horizontal or vertical mounting position;

b) the minimum distance from the body at which a flexible lead may be bent at right angles; and

c) for stud-mounted devices, the maximum torque and where appropriate, the minimum torque which may be applied under specified conditions.

5.5.2.3 *Additional ratings*

Where appropriate, for certain applications, additional information may need to be given, for example, limiting values for acceleration, shock and vibration, environmental conditions, etc.

5.5.3 *Mechanical Characteristics*

5.5.3.1 *Type of termination*

The type of termination (for example, wire-ended, strip, stud, etc) should be indicated.

5.5.3.2 *Dimensions*

Where applicable, reference to outlines and bases specified in IS 5000 series shall be made, otherwise outline drawing (and base, base drawing where appropriate) showing dimensions with appropriate tolerances shall be given.

5.5.3.3 *Additional characteristics*

Where appropriate for certain applications, additional information may need to be given, for example, the weight of the device.

5.5.4 *Other Data*

5.5.4.1 *Method of attachment*

The manufacturer's intended method(s) of attachment (for example, soldering, welding, wrapping) of the termination(s) should be indicated, together with guidance on the preferred conditions during attachment.

5.5.4.2 *Identification*

a) *Type identification*

The method of type identification should be indicated, for example, colour coding.

b) *Terminal identification*

Terminal identification should be stated. Any electrical connection between an electrode and the case should also be stated.

c) *Polarity of the terminals*

Where appropriate, the polarity of the terminals should be indicated.

5.5.4.3 *Additional data*

Where appropriate, any other significant data should be stated.

Examples are:

a) Data concerning the use of electrically insulating washers; and

b) Data concerning the means for obtaining good thermal contact.

5.6 Production Spread and Compliance

5.6.1 The statement of maximum and/or minimum value(s) implies that the value of the characteristic lies at (or between) the stated limits.

In commercial dealings involving particular lots of semiconductor devices the proportion of devices having characteristic values outside the maximum and/or minimum limits in the lot sold and the methods of verification are a matter for agreements between the supplier and the purchaser.

Such methods, based on an agreed statistical probability, permit an agreed percentage of devices to fall outside the stated limits.

5.7 Printed Wiring and Printed Circuits

5.7.1 If, in the cleaning of assemblies which include semiconductor devices, the intention is to use either ultrasonic methods and/or solvents, the semiconductor device manufacturer should be consulted as to the possible deleterious effect of these methods on the devices concerned.

6 MEASURING METHODS

6.1 Basic Requirements

6.1.1 *Introduction*

The measuring methods described in this series, outline the principles employed but not the detailed techniques for practical application. Where tolerances are given, they can only be used as guidance for the maximum deviations from absolute circuit values that are permissible in practical application. Where tolerances associated with conditions of measurement are provided, they should be used as guidance for the maximum deviations from absolute circuit values that are permissible in practical measuring systems.

Where several methods of measuring one parameter are described, it is implied that each method is suitable, although some methods are more accurate than others and some are more suited to production testing.

6.1.2 *General Precautions*

NOTE — The precautions described in this clause are generally valid for discrete devices and integrated circuits. Special precautions for particular device categories are given together with the measuring methods for the relevant categories.

6.1.2.1 *Protection of devices and measuring equipment*

a) *Limiting values*

The test conditions for all measurements should be such that the limiting values of the device are not exceeded. It is recommended that devices should not be inserted into or removed from a circuit while it is energized.

b) *Power supplies*

All power supplies should be clamped to protect the device being measured from possible damage caused by transient phenomena and surges during switching, adjustment and measurement.

c) *Measurement instruments*

It is advisable to protect the meters against heavy overloads arising from faulty semiconductor devices or incorrect connection. Diodes may be included in circuits in order to protect amplifiers in oscilloscopes from unwanted half-cycle pulses.

6.1.2.2 *Accuracy of measurement*

a) *Thermal equilibrium conditions*

All electrical tests should be conducted under thermal equilibrium conditions unless otherwise specified or unless the measurement is performed under pulse conditions. When test conditions cause a significant change with time of the characteristic being measured, means of compensation for such effects should be specified; for example, the length of time that the device should be maintained at test conditions before making a measurement.

Thermal equilibrium may be considered to have been achieved if doubling the time between the application of power and the measurement causes no change in the indicated result within the expected error.

b) *Power supplies*

Power supplies ripple should not effect the desired accuracy of the measurement.

c) *Circuit conditions*

If low currents are measured, suitable precautions should be taken to ensure that parasitic circuit current or external leakage currents are small compared with the current being measured.

Care should be taken to ensure that stray capacitance and inductance values have no effect on the measurement result within the desired accuracy, or alternatively that the effects of stray capacitance and inductance are taken into account in the result.

Coupling or bypassing capacitors should present effective short circuits at the measurement frequency. Where of coupling is important, the necessary components and/or mounting conditions of the device should be as specified.

Care should be taken to minimize spruious oscillations or distortions likely to affect the accuracy of the measurement.

d) *Lighting conditions*

When a characteristic is known to be light sensitive, the effect of lighting conditions should be taken into account.

e) *Measuring instruments*

For any device carrying large currents, separate current-carrying and voltage-measuring contacts should be used. When this is not possible, corrections may have to be made to the measured values of inter-terminal voltages.

In addition, for high-current devices, residual inductance should be as low as possible.

The input and output waveforms of rectifying and converting circuits may be distorted from sinusoidal. Conventional sinusoidal conversion factors are not applicable to distorted waveforms for example, from average to rms or crest values.

Therefore, allowance should be made in the measuring process. Allowances must be made for the voltage drop across current measuring circuits and for the current taken by voltage measuring circuits if these are significant.

6.2 Specific Requirements

These shall be as specified in subsequent parts of the series.

6.3 Numbering System for Measuring Methods

6.3.1 *Numbering Principle*

Measuring methods for integrated circuits are numbered in the sequence irrespective to the type of integrated circuit.

NOTE — The number of each measuring method is reproduced in a 'box', after the title of the relevant measuring method.

6.3.2 *Numbering List of Measuring Methods for Integrated Circuits*

No.	*Characteristics to be Measured*	*Reference Standard*
1	Total current drawn from the power supplies under dynamic conditions	Part 3 Sec 3
2	Power supplied through the clock line	Part 3 Sec 3
3	Propagation times (except MOS circuits)	Part 3 Sec 3
4	Delay times	Part 3 Sec 3
5	Transition times	Part 3 Sec 3
6	Input and output capacitances for large-signal operation	Part 3 Sec 3
7	Propagation times (MOS circuits)	Part 3 Sec 3
8	Set-up time	Part 3 Sec 3
9	Hold times	Part 3 Sec 3

No.	*Characteristics to be Measured*	*Reference Standards*
10	Switching frequency	Part 3 Sec 3
11	Equivalent input/output capacitances/resistances	Part 3 Sec 3
12	Input regulation/stabilization coefficients	Part 6 Sec 3
13	Ripple rejection ratio	Part 6 Sec 3
14	Load regulation/stabilization coefficient	Part 6 Sec 3
15	Output noise voltage	Part 6 Sec 3
16	Temperature coefficient of regulated output voltage	Part 6 Sec 3
17	Stand-by (quiescent) current	Part 6 Sec 3
18	Short-circuit current	Part 6 Sec 3
19	Reference voltage	Part 6 Sec 3
20	Transient response to changes of input voltage	Part 6 Sec 3
21	Transient response to changes of load current	Part 6 Sec 3
22	Power supply currents	Part 6 Sec 2
23	Small-signal input impedance	Part 6 Sec 2
24	Output impedance	Part 6 Sec 2
25	Input offset voltage	Part 6 Sec 2
26	Bias voltage	Part 6 Sec 2
27	Input offset current	Part 6 Sec 2
28	Input bias current	Part 6 Sec 2
29	Input offset voltage temperature coefficient	Part 6 Sec 2
30	Input offset current temperature coefficient	Part 6 Sec 2
31	Open-loop voltage amplification	Part 6 Sec 2
32	Cut-off frequency (frequencies)	Part 6 Sec 2
33	Common-mode rejection ratio	Part 6 Sec 2
34	Supply voltage rejection-ratio	Part 6 Sec 2
35	Output voltage range	Part 6 Sec 2
36	Resolution time	Part 3 Sec 3
37	High-level and low-level output voltage	Part 3 Sec 2
38	High-level and low-level input currents	Part 3 Sec 2
39	Response times (delay-, slope-, ripple-, total response time)	Part 6 Sec 2
40	Short-circuit output current (of a digital circuit)	Part 3 Sec 2
41	Power supply current under static conditions (of a digital circuit)	Part 3 Sec 2
42	Common-mode input voltage range	Part 6 Sec 2
43	Short-circuit output current (of an operation amplifier)	Part 6 Sec 2
44	Channel separation, crosstalk attenuation (for multiple amplifiers)	Part 6 Sec 2
45	Upper limiting frequency for full output voltage swing	Part 6 Sec 2

No.	*Characteristics to be Measured*	*Reference Standards*
46	Maximum rate of change of the output voltage (slew rate)	Part 6 Sec 2
47	Input bias current temperature coefficient	Part 6 Sec 2
48	(Input) threshold voltage and hysteresis voltage	Part 3 Sec 3
49	Output enable and disable times (for three-state)	Part 3 Sec 3
50	Address access time	Part 3 Sec 3
51	Chip select access time	Part 3 Sec 3
52	Read access time	Part 3 Sec 3
53	Write recovery time	Part 3 Sec 3
54	Minimum write pulse duration (width)	Part 3 Sec 3
55	Cut-off frequency, unity-gain frequency	Part 6 Sec 2
56	Static on-state resistance	Part 6 Sec 4
57	Control feed-through voltage	Part 6 Sec 4
58	Off-state switch isolation	Part 6 Sec 4
59	Harmonic distortion (under consideration)	Part 6 Sec 4
60	Cross-talk attenuation	Part 6 Sec 4

7 ACCEPTANCE AND RELIABILITY OF INTEGRATED CIRCUITS

7.1 Electrical Endurance Tests

7.1.1 *Purpose and Presentation*

Endurance tests as well as the failure-defining characteristics and failure criteria are standardized for each device category or sub-category of integrated circuits. This permits a unique and easy comparison of data presented by different manufacturers, relative to acceptance testing as well as to reliability testing.

For a particular device category or sub-category, these standards are given on the following places:

a) **7.1.2**, entitled 'General requirements' gives general standards for the endurance tests, that are valid for all integrated circuits.

b) **7.1.3**, entitled 'Specific requirements', indicates in a general way those requirements that are different for the various device categories or sub-categories.

The necessary details on these specific requirements are given in the relevant standards.

7.1.2 *General Requirements*

7.1.2.1 *Conditions for electrical tests*

a) *Mode of operation*

The device shall be operated under steady-state (dc, ac or dynamic, as appropriate) conditions. In some cases, intermittent or other modes of operation may be necessary as supplementary tests.

b) *Mounting conditions*

i) *Ambient-rated devices*

The free lead length between the point of emergence of the leads from the case and the electrical contacts or support(s) should be preferably not less than 5 mm for devices having leads of uniform cross-section throughout their length. When a design feature (for example, a change in lead cross-section or bend) is provided to limit the depth of insertion of the device into its mounting, the contact or support should be placed as close to this feature as is practical, on the end of the lead away from the device.

Devices with lead length less than 5 mm shall be mounted in accordance with the manufacturers recommendations. The contacts or supports shall be at a temperature not lower than the ambient temperature.

ii) *Case-rated devices*

The device shall be mounted so that the specified case temperature is maintained.

c) *Operating temperature*

The operating temperature may be reached partly by dissipation of the device and partly by the ambient temperature.

The operating temperature shall be maintained within ±5°C for ambient rated devices. For case-rated devices, the average of the temperatures of the cases shall be maintained within ±5°C and any individual case temperature shall be maintained within ±10°C of the specified operating point.

d) *Operating voltages*

The operating voltage(s) used for electrical testing should be stated in the relevant specification for endurance testing. The voltage is applied according to the specified test conditions (*see* **7.1.3.2**).

Initial tolerance and any variation of the voltage at the device terminals during operation shall be within +5 percent of the specified voltage.

e) *Operating currents*

The output current should be specified in the relevant standard.

f) *Test circuit*

Test circuits are specified in the relevant standards. Where appropriate, steps should be taken to prevent oscillations.

7.1.2.2 *Duration of test*

The duration of the test shall be selected from the following list:

168^{+16}_{-10} hours	672^{+20}_{-30} hours	2 000 hours 5 000 hours
336^{+16}_{-20} hours	$1\,000^{+36}_{-30}$ hours	10 000 hours

If intermediate measurements are made, they shall also be performed at the time intervals given in the list above.

7.1.2.3 *Failure-defining characteristics and measurements*

a) *Characteristics*

Those characteristics that are of major importance for the specified device category shall be selected.

b) *Measurement conditions*

All characteristics shall be measured within 96 hours after removal of the devices from the test.

Measurements shall be made at an ambient or reference-point temperature of 25±5°C.

In determining failure, measurements may be referred to values at 25°C when necessary. For attributes testing, data may be taken by making measurements on a go/no-go basis (measured values are compared with failure criteria and each device is considered to have passed or failed). For variables testing, the devices shall be individually identified and the value of each specified characteristic of each device shall be measured.

7.1.2.4 *Failure criteria*

Each device, which, after test, does not meet the limits of one or more of the characteristics specified for its device category is considered to be a failure.

7.1.2.5 *Precautions*

a) *Measurement sequence*

Measurements may be made in any sequence, unless otherwise specified.

b) *Loss or removal of bias*

Bias voltages and/or currents shall be supplied to devices for a total time equal to the specified test time (within the allowed tolerance). It is preferable that voltage bias(es) continue to be applied to devices until they have cooled to room temperature unless it can be established, for the given device type and test conditions, that no significant change of characteristics occurs when the device is cooled with the bias removed.

7.1.3 *Specific Requirements — General*

7.1.3.1 *List of endurance tests*

For the device category or sub-categories a choice of endurance tests is given in the relevant standards.

7.1.3.2 *Conditions for endurance tests*

Test conditions and test circuits, for the device category or each of the sub-categories, are given in a table. The relevant specification will state which test(s) will apply.

7.1.3.3 *Failure-defining characteristics and failure criteria for acceptance after endurance tests*

Failure-defining characteristics their failure criteria and measurement conditions, for the device category or for each of the subcategories, are selected and listed in the relevant standards.

7.1.3.4 *Failure defining characteristics and failure criteria for reliability*

Under consideration.

7.1.3.5 *Procedure in case of a testing error*

When a device has failed as a result of a testing error (such as a test equipment fault or measurement equipment fault, or an operator error), the failure shall be noted in the data record with an explanation of the cause.

8 ELECTROSTATIC — SENSITIVE DEVICES

8.1 Handling Precautions

8.1.1 These precautions apply to the storage, transport, handling and testing of electrostatic-sensitive devices.

8.1.2 Electrostatic-sensitive devices require special handling since the discharge of electrostatica energy from, for example, unearthed equipment or operators produces voltages that, when applied to the terminals, could destroy the device, even if the device contain protection circuits. The following recommendations should be followed.

8.1.3 *General Recommendations*

Electrostatic-sensitive devices without external protection should not be allowed to come into direct contact with electrostatically chargeable materials, for instance, plastic bags, plastic foils, expanded polystyrene, etc, unless the exposed leads have been temporarily shorted. In particular, personnel should avoid touching the terminals.

Electrostatic-sensitive devices should not be brought near strong electric fields, even if in a protective package.

In the testing and use of electrostatic-sensitive devices, suitable precautions should be taken for unused inputs, such as connecting them either to a supply voltage terminal or to the reference terminal.

8.1.4 *Packaging*

Each electrostatic-sensitive device should be adequately packed to prevent the build-up of static charge on individual leads. This is achieved by interconnecting all the leads, for instance by wire, springclip, metal foil, metal eyelet, electrostatically non-chargeable plastic rail, or by mounting the device on conductive material.

A warning label and, if possible, adequate instructions should be included in the package so that they are encountered before it is possible to have access to the device.

8.1.5 *Transport and Storage*

Electrostatic-sensitive devices should be transported and stored in the original packing or a package providing equivalent protection.

8.1.6 *Working Area and Handling*

Working areas where electrostatic sensitive devices are handled, in any way, should be constructed to avoid the build-up of electrostatic charges.

One method of avoiding the build-up of electrostatic charges is to use conducting material and to ensure that the operators, tools and equipment are at essentially the same potential as the working surface.

Wherever possible, the relative humidity of the air should exceed 50 percent.

NOTE — In any case, attention must be paid to the national regulations on personnel safety.

8.2 Label and Symbol

8.2.1 *Introduction*

A number of semiconductor devices and integrated circuits may be subject to permanent damage due to electrostatic potentials encountered in routine handling, testing and shipping, unless appropriate precautions are observed.

8.2.2 *Purpose*

It is the purpose of this standard to provide a distinctive symbol and label to be used for those electrostatic sensitive devices that require special handling. The symbol or label should be used at the innermost practical level of packaging and on the device itself if space permits. It may also be used on device data sheets, on storage bins, and on special protective wrapping materials. The symbol is intended for use where available space does not permit the use of a label.

8.2.3 *Symbol*

In Fig. 1, the symbol is shown suitable for reproduction. Monochromatic reproduction in any colour that contrasts with the background may be used. Wherever possible, the colour red for the symbol should be avoided as red suggests a personal hazard.

8.2.4 *Label*

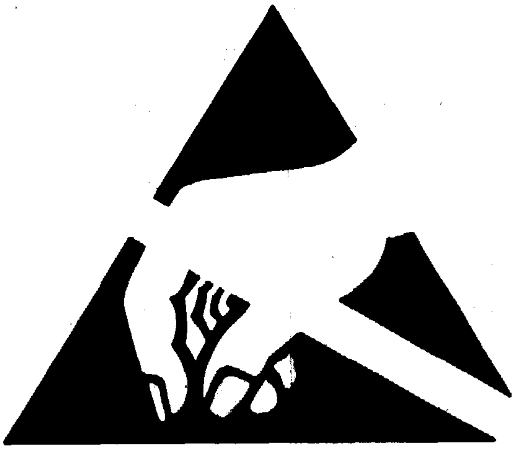
The label comprises the above symbol with the word: ATTENTION — OBSERVE PRECAUTIONS FOR HANDLING — ELECTROSTATIC SENSITIVE DEVICES, according to the design in Fig. 2. Where practicable, the symbol and lettering should be black on a yellow background.

8.2.5 *Device Marking*

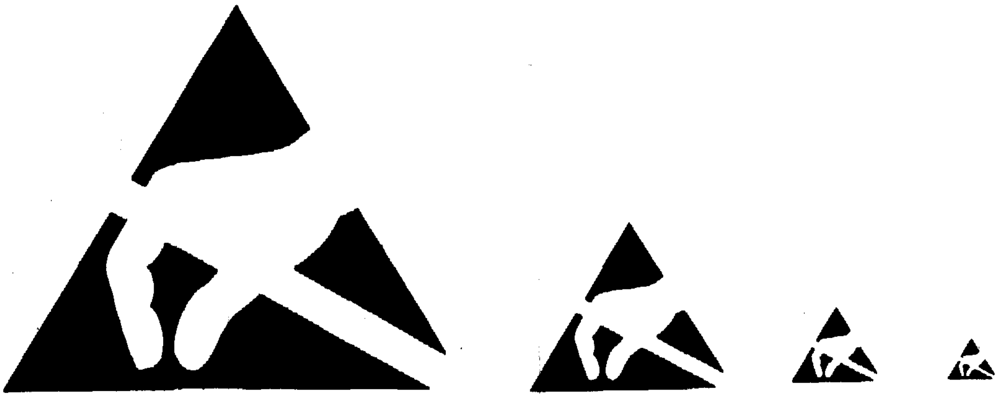
If space permits, the device may be marked with the simplified version of the symbol specified in **8.2.3** at a reduced size as shown in Fig. 1.

8.3 Test Methods

Under consideration.



1A Basic Symbol



1B Simplified Version for Extreme Reduction

FIG. 1 BASIC AND REDUCED SYMBOLS

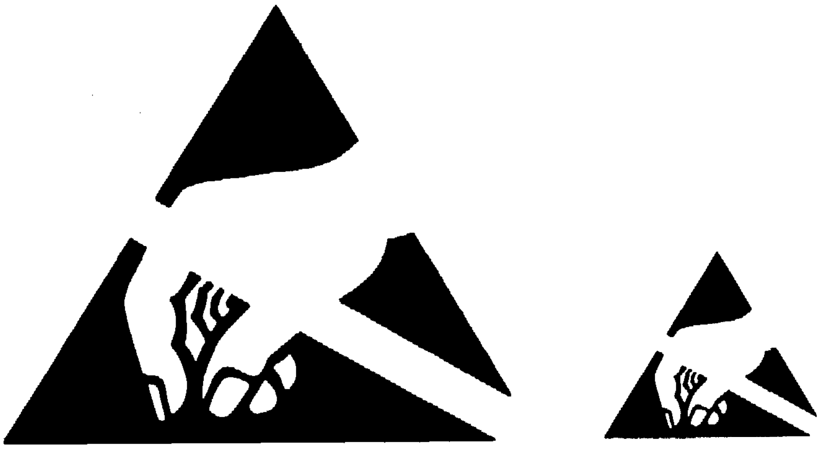


FIG. 2 LABEL SHOWN IN TWO SIZES.

Standard Mark

The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act, 1986* and the Rules and Regulations made thereunder. The Standard Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well defined system of inspection, testing and quality control which is devised and supervised by BIS and operated by the producer. Standard marked products are also continuously checked by BIS for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.